Yana Operations

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The Yana control program completely fills the Nano program memory. There is no room for any added functionality.

I. The HOME Screen

HOME

The screen below is called the **HOME Screen**. The top row is called the **Command Line**. Other rows are called **Frequency Lines**. The top right corner of the HOME screen is called the HOME position. The HOME screen is shown with several possible choices.

> **Note:** The battery voltage is displayed in the upper right part of the screen. Useable range is assumed to be 7-9V and percent charge is calibrated for NiMH batteries:
>
> **Green** if above 20% charge,
> **Yellow** between 5% and 20% of charge, and
> **Red** if below 5% charge.
>
> I've found that much below 7v the regulators may drop out which radically alters accuracy. For two series connected 18650 Li-Ion batteries I use Yana until voltage drops to about 6.8V.

Suppose we wish to sweep a 30MHz (High Frequency) antenna low pass filter over Yana's entire range, measuring to find spurious responses and low attenuation. The **leftmost screen** sweeps Yana's entire range using the **Scalar Network Analyzer (SNA) instrument** with frequencies indicated (S) in Start/Finish fashion. The grid (10) will have 10db steps, and Yana is in the run (**R**) mode. The Start Frequency is 50,000Hz and the Finish Frequency is 70,000,000Hz. A Left Marker is placed at 14.04MHz and a Right Marker at 56.01MHz: 1/4 way through the range. Yana is using the SNA instrument, showing Start/Finish frequencies, with 10db steps on the graph. Yana is ready to run the sweep.

Suppose next (**second screen**) we wish to measure the response of an 80m bandpass filter, including responses at the band edges and the skirts of the filter up to 1.25MHz from the center of the band. The second screen shows Yana in **SNA** mode, with frequencies **(C) in Center/Radius** fashion. The graph is set (3) to have grid steps of 3db. Yana sweeps the 80m band from 2.5MHz to 5MHz, (centered at 3.75MHz with radius 1.25MHz each way from this center) with markers at 3.5MHz and 4.0MHz (distance 250KHz each way from the center): the band edges. Further, Yana is ready to run (R).

Now (**third screen**) check a 40m dipole for its SWR over the band with the SWR Bridge mounted on Yana. The third screen shows Yana ready to sweep a 40m antenna with the SWR instrument (technically, Yana computes VSWR). The **SWR instrument** is selected in (S) Start/Finish fashion, beginning at 7MHz and ending at 7.3MHz. The grid (1) will have SWR 1 steps. Markers are set at 7.1MHz and 7.2MHz. Yana is set to run (R).

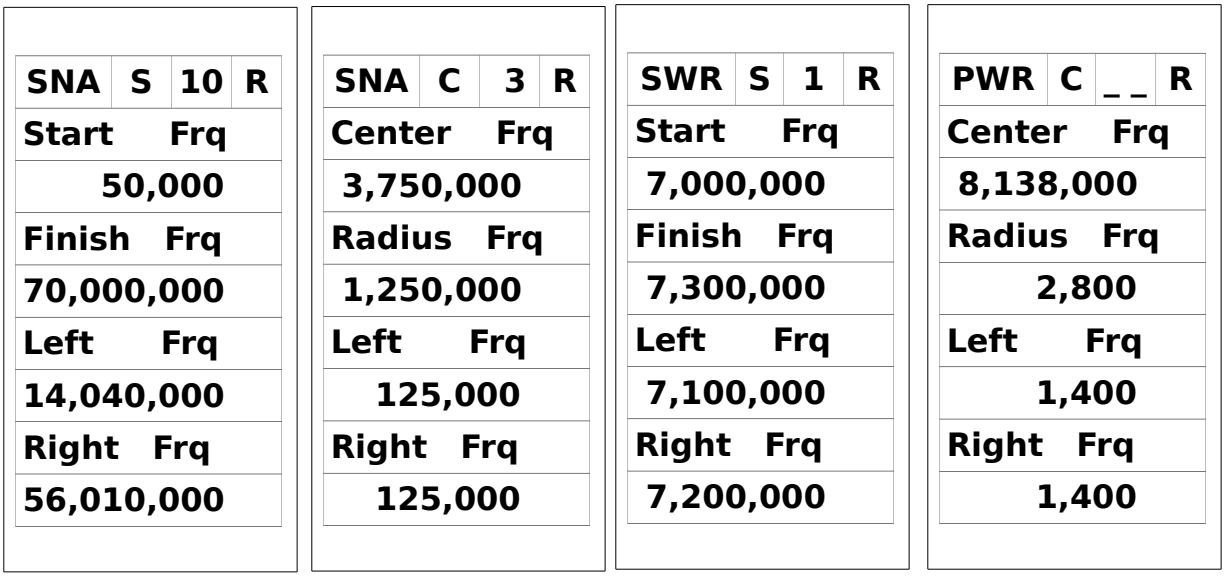
Suppose we wish to find the 3db points of a 8.138MHz crystal filter of 2.8KHz nominal bandwidth by measuring power through the filter (**fourth screen**). The 3db/60db shape factor is supposed to be 2:1 so the 60db bandwidth should be 5.6KHz. The radius from the center frequency would be 2.8KHz

(half the 2:1 bandwidth). The radius to the bandwidth edges should be half the expected 3db bandwidth: 1.4KHz, so **markers** are placed there.

The DDS in Yana is independent of the power detector. Therefore it is left running and tunable when in the **Power (PWR) instrument**. Feeding the DDS to the filter enables output to be measured using the PWR instrument in Yana. The DDS output is falling throughout its range but is fairly constant over a 5.6KHz range around 8MHz. If there is concern, the power meter instrument (PWR) in Yana will measure the DDS output at any frequency either through the filter or directly.

Record the filter response at the center of the filter: 8.138MHz. Tune either side of center until the output falls 3db.

The fourth screen shows Yana set to the power meter (PWR) instrument. The frequencies (C) are set for Center/Radius. There is no graph so no graphing dimensions (_ _) are given, and Yana's operation is set to run (R). The center frequency is 8.138MHz, the radius is 2.8KHz: tuning will be in this range. The markers are set either side of center at 1.4KHz but they have no relevance so could be set arbitrarily.



SNA	S	10	R
Start		Frq	
50,000			
Finish		Frq	
70,000,000			
Left		Frq	
14,040,000			
Right		Frq	
56,010,000			

SNA	C	3	R
Center		Frq	
3,750,000			
Radius		Frq	
1,250,000			
Left		Frq	
125,000			
Right		Frq	
125,000			

SWR	S	1	R
Start		Frq	
7,000,000			
Finish		Frq	
7,300,000			
Left		Frq	
7,100,000			
Right		Frq	
7,200,000			

PWR	C	_ _	R
Center		Frq	
8,138,000			
Radius		Frq	
2,800			
Left		Frq	
1,400			
Right		Frq	
1,400			

Possible values for control function fields are given below.

Instrument Field	Start/Center Field	Graph Field Scale	Operation
SNA SWR PWR SNL SNC	S C	10/3 1/.5 _ _	R C

Instrument Field

(SNA) the network analyzer instrument.
(SWR) the swr meter (with bridge installed).
(PWR) the power meter instrument.
(SNL) the network analyzer computes inductance in nH in graph tuning mode.
(SNC) the network analyzer computers capacitance in pF in graph tuning mode.

Start/Center Field

(S) list frequencies in start/finish mode.
(C) list frequencies in center/radius mode.

Graph Field Scale

(10) 10db per grid mark.
(3) 3db per grid mark.
(1) 1 swr per grid mark.
(.5) .5 swr per grid mark.

Operation Field

(**R**) Yana is ready to run.
(**C**) Yana is ready to calibrate.

Each time Yana starts, it is set for all HF ham bands: 1-31MHz with markers at 1.8MHz and 29.7MHz.

HOME Position

This is a **very important position to remember**. The HOME screen is showing, R is in the upper right corner, and the cursor is on R.

Buttons

Click: Depress and release the button quickly.
Push: Depress the button until the screen goes black.
Hold: Depress the button until the screen goes black and then the screen turns blue.
Turn: Turn the knob.

Button Actions

On the HOME screen, Hold always returns Yana to the HOME position with the following exception:

a **Hold in the HOME position executes the command** set up by the Home Screen.

The Button on the HOME Screen

Click:

Move the cursor along the selected row. (On a frequency, it sets the decade [stepping in 100's] for tuning. On the Command Line clicking moves from field to field.)

Push:

Advance to the next lower line except on the bottom line. From the bottom line, Push sends the cursor to the Center or Start Frequency Line.

Hold:

Returns to the HOME position with the run (R) operation set except when already in the

HOME position. In the HOME position, Hold executes the command.

Turn:

On a Frequency line, the frequency tunes according to the cursor location. (Click to change that.) Clicking moves the cursor two positions to the right (or cycles back to the Mhz position).

On the Command Line, turning selects the possibilities for a command (instrument, frequency fashion, graphing dimension, or operation). Commands do not cycle so the knob must be turned the other way when at the end of choices.

Note: Yana operates as follows. When the knob is turned, an interrupt records the change. This change is not immediately noted. As Yana checks tasks, eventually the accumulated knob turning is recorded and displayed. The occasional checking is called "polling." That is, the rotation is recorded immediately by an interrupt but Yana only notes it when the possibility of a rotation is polled. Generally Yana is so fast this polling is not noticeable.

The button also generates an interrupt which is also polled regularly. In other words, button clicks are never lost. Sometimes, the effect of polling is delayed while Yana does other things. This may cause a slight delay from what you expect.

Note: Yana may be used as a **generator** or **vfo**. Put the cursor on the **Start Frq** line in (**S**) mode. Tuning the Start Frequency will tune Yana's generator output frequency. Or, just put Yana into Power Mode (PWR).

II. The SNA Graphing Screen

Yana sweeps the range and graphs the readings. Two vertical steps are set on the HOME screen: 10db or 3db. The top of the screen is 0db and the bottom is either -21db or -70db.

Graphing Range	Vertical Grid
70db	**10db**
21db	**3db**

Graphing commences in continuous mode. **Turning the knob** switches between slow, medium, and fast sweep. Fast graphing is a bit annoying so a slow mode is provided if adjustments allow this slower redrawing. A **Click** stops graphing and goes to the graph tuning mode. Continuous graphing is useful for real-time tuning (e.g. an antenna coupler or a bandpass filter). The graph cannot be modified so that Yana repeatedly draws the current graph, pauses, blanks the screen, then repeats by redrawing the new graph. A **Push** sends the graphing data in .csv format (frequency, db) to the PC over the USB port.

Click: Go to graph tuning mode.
Push: Send the next graph scan to the PC via the USB port at 115200 baud.
Hold: Go Home.
Turn: Alternate between fast and slow graphing.

Graph Tuning Mode.

The following table shows the SNA graphing data displayed in **SNA Graph Tuning Mode**. Yana is sweeping the full spectrum in SNA mode with the open SWR bridge mounted.

Frequency	db	Meaning
35,025,000	**-11.9**	**Tune**
19,286,228	**-12.4**	**Min**
50,040	**- 9.0**	**Max**
14,040,000	**-12.2**	**L**
56,010,000	**- 11.3**	**R**

The first column is the frequency. The second column is the db down at that frequency. The third column is the meaning of the Frequency.

Min: is the minimum reading, the lowest point on the graph.
Max: is the maximum reading, the highest point on the graph.
L: is the reading at the Left Marker.
R: is the reading at the Right Marker.

Turning the knob changes the Tune frequency. Think of the knob as tuning along the curve on the graph. A new reading is taken at the new frequency. Tuning is over the range of the graph, i.e. between the minimum and maximum graphed frequencies. The stepsize for tuning can be changed by clicking the button. **Tuning does not read the graph:** it takes a new detector reading each time the frequency is changed.

> **Note:** When tuning the readings may be different from the SNA graphing data and may change when retuning the same frequency. The graphing values are read from the Detector exactly once and recorded. However, when tuning, the detector is read 8 times then averaged. Even at that, changes with noise, variations in digital conversion, and variability in circuits can cause small changes in a short time. When tuning, a reading is taken each time the knob is turned one click. Between turning clicks, no readings are taken. To see the variations at one frequency, tune back and forth. Yana's precision (number of decimal places shown) exceeds her accuracy (how accurate she really is) so that you can make the choice of what to believe.

The Button in SNA Graph Tuning Mode

Click: change the tuning step size.
Push: return to continuous graphing.
Hold: go HOME.
Turn: change the **Tuning** frequency.

III. The SWR Graphing Screen

Yana sweeps the range and graphs the readings. Two vertical steps are set on the HOME screen: SWR 1 or SWR 0.5. The top of the screen is 1.0 VSWR and the bottom is either 4.5 VSWR or 8.0 VSWR.

Graphing Range	Vertical Grid
8.0	**1.0**
4.5	**0.5**

Graphing commences in continuous mode. **Turning the knob** switches between slow, medium, and fast sweep. Fast graphing is a bit annoying so a slow mode is provided if adjustments allow this slower redisplay. A **Click** stops graphing and goes to the graph tuning mode. Continuous graphing is useful for real-time tuning (e.g. an antenna coupler or a bandpass filter). The graph cannot be modified so that Yana repeatedly draws the current graph, pauses, blanks the screen, then repeats by redrawing the new graph. A **Push** sends the graphing data in .csv format (frequency, swr) to the PC over the USB port.

Click: Go to graph tuning mode.
Push: Send the next graph scan to the PC via the USB port at 115200 baud.
Hold: Go Home.
Turn: Alternate between fast and slow graphing.

Graph Tuning Mode

The following table shows graphing data displayed in **SWR Graph Tuning Mode**. Yana is sweeping the full spectrum in SWR mode with a 12.5 ohm load mounted on the bridge. In a perfect world, the VSWR should be 4.0.

Frequency	VSWR	Meaning
35,025,000	**3.9**	**Tune**
632,916	**3.2**	**Min**
50,000	**8.0**	**Max**
14,040,000	**4.0**	**L**
56,010,000	**5.0**	**R**

The first column is the frequency. The second column is the SWR at that frequency. The third column is the meaning of the Frequency.

Min: is the lowest down reading on the graph: the highest VSWR.
Max: is the highest up reading on the graph, the lowest VSWR.
L: is the reading at the Left Marker.
R: is the reading at the Right Marker.

Turning the knob changes the Tune frequency. Think of the knob as tuning along the curve on the graph. A new reading is taken at the new frequency. Tuning is over the range of the graph, i.e. between the minimum and maximum graphed frequencies. The stepsize for tuning can be changed by clicking the button. **Tuning does not read the graph:** it takes a new reading each time the frequency is

changed.

> **Note:** When tuning the readings may be different from the SWR graphing data and may change when retuning the same frequency. The graphing values are read from the Detector exactly once and recorded. However, when tuning, the detector is read 8 times then averaged. Even at that, changes with noise, variations in digital conversion, and variability in circuits can cause small changes in a short time. When tuning, a reading is taken each time the knob is turned one click. Between turning clicks, no readings are taken. To see the variations at one frequency, tune back and forth. Yana's precision (number of decimal places shown) exceeds her accuracy (how accurate she really is) so that you can make the choice of what to believe.

The Button in SWR Graph Tuning Mode

Click: change the tuning step size.
Push: return to continuous graphing.
Hold: go HOME.
Turn: change the **Tuning** frequency.

IV. The PWR Screen

WARNING! Do not present the meter with more than +10dbm (10mW or 0.7V ... 100W is 70.7V [100 times too many volts]). High voltage will fry the AD8307 and burn out the input circuitry. Use the 40db tap for powers up to 100watts. [The Hayward, Larkin tap is only good up to 60W. The Yana tap will handle 100 watts continuously.]

With the 40db tap, 40db should be added to the dbm reading, watts should be multiplied by 10,000, and volts should be multiplied by 100. If the load on the Yana tap is not 50 ohms resistive, all readings are suspicious.

Yana measures its wide range detector and registers the total power in its total bandwidth. Thus when connected to an antenna, Yana will measure all the power present at every frequency. Yana performs best in a 50 ohm environment when given specific frequencies whose total power has meaning. Yana calibration is good from 50KHz to 200MHz.

The power display screen is shown below. The SWR bridge is attached with a 12.5 ohm load.
The Generator is connected through the bridge so that the power is that of the Generator minus the loss through the bridge.

Power
-63.3 dbm
471 pW
153 uV

143
Frequency
16,000,000

The number 143 is the ADC raw reading. The voltage regulator on the AD8307 is about 5V. This 5V is divided into 1024 steps. Thus the voltage recorded by the ADC is about (143/1024)x5 = 0.7V. The regulator is not perfect so calibration properly scales the power reading. The 153uV is voltage for -63.3dbm power into 50 ohms.

The power meter function does not need the generator so the Generator is available for any use. The Generator can be fed directly to the power meter and tuned through its range to determine the power output at any frequency. The Generator can be fed through a filter to the power meter and tuned through the range of the filter. The power of the generator varies between 0dbm and 1.2dbm in the range 50KHz to 14MHz. From there it drops off to about -19dbm at 70MHz.

Do not be deceived by Yana's readings. The AD8307 measures up to 200MHz +-1db. The ADC measures voltage in steps which are about 0.2dbm. An ADC is always +- 1count (or in a 0.4dbm range). Readings are determined by the the voltage regulators on the Nano and AD8307 modules. These are neither high accuracy or super stable. Accuracy is improved by calibrating Yana. Instability causes slight variation in readings.

The precision (number of decimals presented) of Yana always exceeds the accuracy (closeness to true value). This is intentional so that you can make the choice of what a reading means.

V. (SNL) and (SNC) Measure inductance and capacitance

The SNL and SNC instruments operate exactly like the SNA position with a couple exceptions. In graph tuning mode, the minimum frequency is replaced by picofarads (pF) or nanohenrys (nH). The LC attachment must be mounted for LC measurements. The Yana firmware assumes a L-standard of 1.2uH (used when measuring capacitance) and a C-standard of 680pF (used when measuring inductance).

When in continuous graph mode, a Push puts Yana into the **Set Standard** mode. For SNL, the C-standard can be changed. For SNC, the L-standard can be changed. The Yana default standards were selected to give ranges approximating those used for building High Frequency tuned circuits. Yana performs well in the HF range (between 1 and 31MHz).

When in Set Standard mode, a turn changes the value, a click moves the tuning decade, a push goes to continuous graph mode, and a hold goes HOME.

If you are a microhenry person (uH), take the right-most comma as a decimal point and read microhenrys in place of nanohenrys.

Note: When scanning, Yana takes only 120 steps to complete a graph and therefore, the graph steps can be quite large. The minimum on the graph is the frequency where the LC circuit in the fixture resonates. To refine this minimum, Yana starts averaging 8 readings at a time and hunts for a better minimum near the first minimum found. This takes considerable time. Therefore, you are asked to

wait when going into graph tuning mode, while Yana perfects the inductance or capacitance shown to you.

VI. (C) Calibrate in the Home Position

Executing this command starts Yana's calibration procedures. These are covered in the **Calibration** section of the documentation.

VII. USB – PC connection to Yana

The usb connection (U) is currently not implemented. Rudi DL5FA implemented a computer connection to vnaJ. Yana is a scalar analyzer and vnaJ is a vector program. It was assumed that the Yana reading was magnitude (a correct assumption), but the phase angle was always zero, converting a scalar reading to a vector reading. Assuming the phase is always zero leads to incorrect readings when sweeping antenna SWR for many antennas, and behaves strangely in other modes. Those who know how to use a Smith Chart can draw a constant SWR circle. Traveling around this circule shows how really terrible the assumption of phase equal zero can be.

The vnaJ code exhausted the Nano's program memory leaving no room for added features. Since the vnaJ connection is of dubious value, it was removed leaving room for the LC measuring feature of Yana.

After the LC addition, there was very little code space left in the Nano so a minimalist PC connection has been implemented. While graphing in the SNA a push will dump the graph in .csv format with lines (frequency, db). While graphing in the SWR a push will dump the graph in .csv fomat with lines (frequency, swr). The dump is 120 points on a graph. This data may be loaded into a spreadsheet and graphed. The data has no label so you must supply that in order to remember which graph is being drawn. The easiest way to load data is via the serial monitor in the Arduino program environment. The data rate is 115200 baud.